University of Tripoli Faculty of Engineering Electrical and Electronic Department
Spring 2015 2nd Midterm Exam **Signals & System (EE302)** Date: 28/05/2015 Time: 1:30 H
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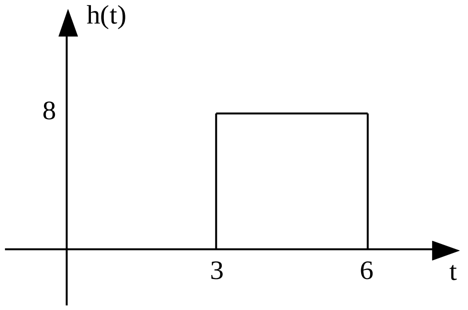
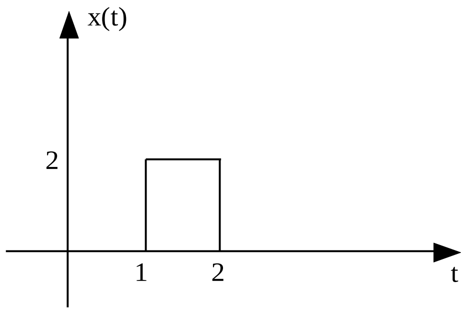
Answer all questions:

Q1) Compute the output signal y(t) for a continuous-time signal whose impulse response h(t) and the input signal x(t). [4]





Q2:- A LTID system is described by the following difference equation [5]

$$y[n] = 2x[n] - 4x[n-2] + x[n-3]$$

a) Draw a block diagram that represent this system.
b) Determine the impulse response $h[n]$ for this system.
c) Find and sketch the zero-state response of this system due to input signal given by $x[n] = \delta[n] - 3\delta[n-2]$.

Q3 - Find the Laplace transform and the associated ROC for each of the following signals: [4]

a) $x(t) = 3\delta(t-5)$
b) $x(t) = 2u(t-3)$
c) $x(t) = 2tu(t+2)$
d) $x(t) = e^{-t}[u(t) - u(t-2)]$

Q4 – In the circuit shown in the figure below the switch is in the closed position for a long time before it is opened at t = 0. The output is the inductor current i(t). [7]

a) Derive the input/output differential equation.
b) Draw the block diagram of the circuit.
c) Find the impulse response $h(t)$.
d) Use Laplace transform to calculate the inductor current i(t) for t ≥ 0.

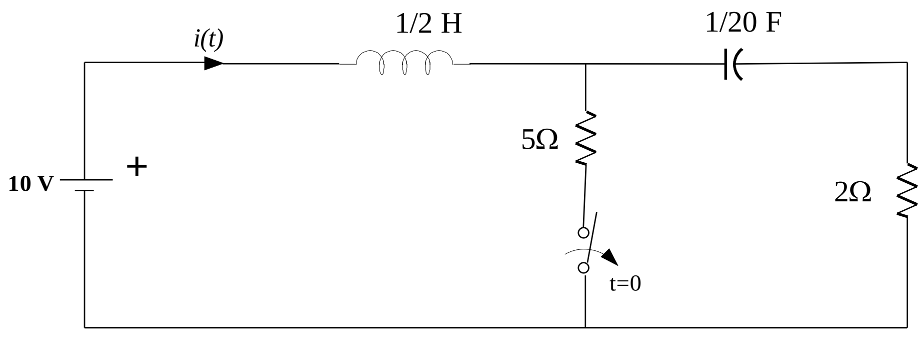


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TABLE 4.1 A Short Table of (Unilateral) Laplace Transforms

No.	$x(t)$	$X(s)$
1	$\delta(t)$	1
2	$u(t)$	$\frac{1}{s}$
3	$tu(t)$	$\frac{1}{s^2}$
4	$t^n u(t)$	$\frac{n!}{s^{n+1}}$
5	$e^{\lambda t}u(t)$	$\frac{1}{s-\lambda}$
6	$te^{\lambda t}u(t)$	$\frac{1}{(s-\lambda)^2}$
7	$t^n e^{\lambda t}u(t)$	$\frac{n!}{(s-\lambda)^{n+1}}$
8a	$\cos bt\, u(t)$	$\frac{s}{s^2+b^2}$
8b	$\sin bt\, u(t)$	$\frac{b}{s^2+b^2}$
9a	$e^{-at}\cos bt\, u(t)$	$\frac{s+a}{(s+a)^2+b^2}$
9b	$e^{-at}\sin bt\, u(t)$	$\frac{b}{(s+a)^2+b^2}$
10a	$re^{-at}\cos(bt+\theta)\,u(t)$	$\frac{(r\cos\theta)s+(ar\cos\theta-br\sin\theta)}{s^2+2as+(a^2+b^2)}$
10b	$re^{-at}\cos(bt+\theta)\,u(t)$	$\frac{0.5re^{j\theta}}{s+a-jb}+\frac{0.5re^{-j\theta}}{s+a+jb}$
10c	$re^{-at}\cos(bt+\theta)\,u(t)$ $r=\sqrt{\frac{A^2c+B^2-2ABa}{c-a^2}}$ $\theta=\tan^{-1}\left(\frac{Aa-B}{A\sqrt{c-a^2}}\right)$ $b=\sqrt{c-a^2}$	$\frac{As+B}{s^2+2as+c}$
10d	$e^{-at}\left[A\cos bt+\frac{B-Aa}{b}\sin bt\right]u(t)$ $b=\sqrt{c-a^2}$	$\frac{As+B}{s^2+2as+c}$

TABLE 4.2 The Laplace Transform Properties

Operation	$x(t)$	$X(s)$
Addition	$x_1(t)+x_2(t)$	$X_1(s)+X_2(s)$
Scalar multiplication	$kx(t)$	$kX(s)$
Time differentiation	$\frac{dx}{dt}$	$sX(s)-x(0^-)$
	$\frac{d^2x}{dt^2}$	$s^2X(s)-sx(0^-)-\dot{x}(0^-)$
	$\frac{d^3x}{dt^3}$	$s^3X(s)-s^2x(0^-)-s\dot{x}(0^-)-\ddot{x}(0^-)$
	$\frac{d^nx}{dt^n}$	$s^nX(s)-\sum_{k=1}^{n}s^{n-k}x^{(k-1)}(0^-)$
Time integration	$\int_{0^-}^{t}x(\tau)\,d\tau$	$\frac{1}{s}X(s)$
	$\int_{-\infty}^{t}x(\tau)\,d\tau$	$\frac{1}{s}X(s)+\frac{1}{s}\int_{-\infty}^{0^-}x(t)\,dt$
Time shifting	$x(t-t_0)u(t-t_0)$	$X(s)e^{-st_0}\quad t_0\geq 0$
Frequency shifting	$x(t)e^{s_0t}$	$X(s-s_0)$
Frequency differentiation	$-tx(t)$	$\frac{dX(s)}{ds}$
Frequency integration	$\frac{x(t)}{t}$	$\int_{s}^{\infty}X(z)\,dz$
Scaling	$x(at),\,a\geq 0$	$\frac{1}{a}X\left(\frac{s}{a}\right)$
Time convolution	$x_1(t)*x_2(t)$	$X_1(s)X_2(s)$
Frequency convolution	$x_1(t)x_2(t)$	$\frac{1}{2\pi j}X_1(s)*X_2(s)$
Initial value	$x(0^+)$	$\lim_{s\to\infty}sX(s)\quad(n>m)$
Final value	$x(\infty)$	$\lim_{s\to 0}sX(s)\quad$ [poles of $sX(s)$ in LHP]